RECIPROCATING COMPRESSOR FOR COMPRESSING REFRIGERANT

TECHNICAL FIELD

The present invention relates to a reciprocating compressor for compressing a refrigerant in a refrigerator, and more particularly, to a reciprocating compressor for compressing a refrigerant that is capable of improving a lubricating performance by using a lubricant with an excellent compatibility with a refrigerant used for a refrigerator and improving a performance of the refrigerator.

BACKGROUND ART

As chlorofluorocarbon (CFC), a refrigerant used for a refrigerator, an air-conditioner or the like, has been known as a source material damaging an ozone layer of the stratosphere, researches on a substitute refrigerant is being actively conducted.

The CFC comprises R11 (trichloromonogluoromethane), R12 (dichlorodifluoromethane), R13 and the like, of which R12 mainly used as a refrigerant for a refrigerator is one of regulation-subject materials as being a source material causing an ozone layer reduction and generating a global warming effect. Thus, researches on a natural refrigerant is being actively conducted as a substitute refrigerant.

The natural refrigerant refers to a material used as a refrigerant which naturally exists in the globe such as water, ammonia, nitride, carbon dioxide,

propane, butane and the like, not an artificial compound. Known that it does not have a bad influence on the global environment, application of the natural refrigerant as a refrigerant is positively reviewed.

Among the natural refrigerants, hydrocarbon comprises only carbon and hydrogen and includes R50 (methane), R170 (ethane), R290 (propane), R600 (butane), R600a (isobutene), R1270 (propylene) or the like. Hydrocarbon is not toxic and chemically stable and especially exhibits an appropriate solubility in a mineral oil.

In addition, the hydrocarbon has a zero ozone depletion potential and a very low global warming index. That is, when a global warming index of carbon dioxide is admitted as '1', a global warming index of R12 is 7100, R134a is 1200, while propane is very low, 3.

Especially, isobutane (R600a) is an environmental-friendly natural gas which does not damage the ozone layer and have no influence on a greenhouse effect. That is, isobutane (R600a), a sort of a natural gas obtained by refining hydrocarbon gas created in an oil refining process to a high degree of purity, is a refrigerant containing no environmentally detrimental factor.

However, with all those advantages, isobutene (R600a) is hardly combined with refrigerant oil currently used for a refrigerating system due to its chemical and electrical properties. Therefore, a refrigerant oil suitable for isobutene (R600a) is in need of development. Especially, necessity of a refrigerant oil usable for a reciprocating compressor for compressing isobutene

(R600a) comes to the front.

As shown in Figure 1, the currently used reciprocating compressor includes: a hermetic container 6 having a suction pipe 2 for sucking a refrigerant and a discharge pipe 4 for discharging a compressed refrigerant each as being connected thereto; a driving unit 8 disposed inside the case 6 and generating a reciprocal motional force; a compression unit 10 for receiving the reciprocal motional force from the driving unit 8 and compressing the refrigerant; and a lubrication unit 12 for lubricating each motional portion of the driving unit 8 and the compression unit 10.

In the reciprocating compressor, when the driving unit 8 is driven and the compression unit 10 makes a compression operation on the refrigerant, the lubrication unit 12 supplies a lubricant 50 stored at the lower portion of the hermetic container 6 to the motional portion of the compression unit, thereby performing a lubricating operation. The refrigerant compressed in the compression unit is the natural refrigerant.

Since the lubricant used for the reciprocating compressor constructed and operated as described above is used as a refrigerant oil for the compressor compressing the natural refrigerant, its physical and chemical properties should be in good harmony with the natural refrigerant.

Namely, the lubricant used as the refrigerant oil of the reciprocating compressor needs to have characteristics that it can protect well an oil film even though the refrigerant is dissolved, should be thermally and chemically stable so as not to react in spite of being in contact with the refrigerant and an organic

material metal at a high temperature or at a low temperature, and should have a high level thermal stability so as not to generate a carbon sludge not to be oxidized at a high temperature part of the compressor.

In order to satisfy those characteristics, characters of the lubricant, such as a kinematic viscosity, a pour point, a density, a total acid number, a water content or the like, work as critical factors.

Therefore, if the lubricant used for the reciprocating compressor compressing the natural refrigerant is not well harmonized with the refrigerant of the refrigerator, the oil would be leaked. Then, oil circulation is deteriorated to degrade a heat transfer performance of the refrigerator and a lubrication performance, resulting in that frictional portions of each motional part are abraded and thus each part is damaged.

DISCLOSURE OF THE INVENTION

Therefore, it is an object of the present invention to provide a reciprocating compressor that is capable of improving a lubrication performance by using a lubricant in good harmony with a natural refrigerant used for a refrigerator, and thus enhancing a performance of a reciprocating compressor.

To achieve these objects, there is provided a reciprocating compressor for compressing a refrigerant including: a hermetic container to which a suction pipe and a discharge pipe are connected; a driving unit having a stator fixed inside the hermetic container and a mover disposed spaced apart from the stator and

linearly and reciprocally moved according to an interaction with the stator; an organic compound refrigerant sucked into the suction pipe, having an combustibility and explosiveness and consisting of only carbon and hydrogen; a compression unit for receiving a reciprocal motional force of the driving unit and making a compression operation on the organic compound refrigerant; and a mineral-based lubricant filled at a lower portion of the hermetic container; and a lubrication unit for supplying the mineral-based lubricant to each motional portion of the driving unit and the compression unit and performing a lubricating operation.

In the reciprocating compressor of the present invention, the stator consists of an outer stator fixed at the hermetic container; an inner stator disposed with a certain air gap with an inner circumferential surface of the outer stator; and a winding coil wound at one of the outer stator and the inner stator, to which power is applied from an external source, and the mover consists of magnets disposed at regular intervals between the outer stator and the inner stator and being linearly and reciprocally moved when power is applied to the winding coil; and a magnet frame having the magnets mounted thereon and transmitting a linear and reciprocal motional force to the compression unit.

In the reciprocating compressor of the present invention, the compression unit includes: a piston connected to the mover and linearly and reciprocally moved; a cylinder, into which the piston is slidably inserted, for forming a certain compression chamber; a suction valve mounted at a refrigerant passage formed at the piston and preventing a backflow of the refrigerant after being introduced into the compression chamber; and a discharge valve mounted at the front side

of the cylinder and performing an opening and closing operation on the compressed refrigerant.

In the reciprocating compressor of the present invention, the lubrication unit includes: a lubricant pumping unit for pumping the lubricant filled as much as a certain amount at a lower portion of the hermetic container; and a lubricant supply passage for supplying the lubricant pumped by the lubricant pumping unit to a frictional portion between the piston and the cylinder.

In the reciprocating compressor of the present invention, the refrigerant is isobutane (R600a) which is hydrocarbon-based and has a molecular formula of $CH(CH_3)_3$.

In the reciprocating compressor of the present invention, the lubricant is a paraffin-based lubricant.

In the reciprocating compressor of the present invention, the lubricant has a density of 0.866~0.880 g/cm^3 at a temperature of 15°C and a flash point of above 140°C.

In the reciprocating compressor of the present invention, the lubricant has a kinematic viscosity of 7.2~21.8 mm^2/s at a temperature of 40°C and a viscosity index of 73~99.

In the reciprocating compressor of the present invention, the lubricant has a flow point of below -25°C and a total acid number of below 0.01 mgKOH/g.

In the reciprocating compressor of the present invention, the lubricant has a water content of below 20 ppm and a breakdown voltage of above 30kV.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view of a general reciprocating compressor for compressing a refrigerant.

MODES FOR CARRYING OUT THE PREFERRED EMBODIMENTS

Figure 1 is a sectional view of a general reciprocating compressor for compressing a refrigerant.

As shown in Figure 1, the general reciprocating compressor includes: a hermetic container 6 to which a suction pipe 2 for sucking a refrigerant and a discharge pipe 4 for discharging a compressed refrigerant are connected, a driving unit 8 disposed inside the case 6 and generating a reciprocal motional force; a compression unit 10 for receiving a reciprocal motional force generated from the driving unit 8 and performing a compressing operation on the refrigerant; and a lubrication unit 12 for performing a lubricating operation on each motional portion of the driving unit 8 and the compression unit 10.

The driving unit 8 includes: a cylindrical outer stator 16 fixed by a support frame 14 fixed inside the hermetic container 6; an inner stator 18 disposed with a certain air gap with an inner circumferential surface of the outer stator 16; a winding coil 20 wound at the outer stator 16, to which power is applied from an external source; and magnets 22 disposed at regular intervals between the outer stator 16 and the inner stator 18 and linearly and reciprocally moved when power is applied to the winding coil 20.

The magnets 22 are fixed at an outer circumferential surface of the magnet holder 24 at equal intervals, and the magnet holder 24 is connected to the piston 26 of the compression unit 10.

The compression unit 10 includes a piston 26 connected to the magnet holder 24 and linearly and reciprocally moved; a cylinder 28, into which the piston 26 is slidably inserted, forming a compression chamber 36; a suction valve 32 mounted at a suction opening 30 formed at the piston 26 and preventing a backflow of the refrigerant after being introduced into the compression chamber 36; and a discharge valve 34 mounted at a front side of the cylinder 28 and performing an opening and closing operation on a compressed refrigerant.

The lubrication unit 12 includes: a lubricant 50 filled as much as a certain amount at a lower portion of the hermetic container; a lubricant pumping unit 40 for pumping the lubricant 50; and a lubricant supply passage 42 for supplying the lubricant 50 pumped by the lubricant pumping unit 40 to a frictional portion between the piston 26 and the cylinder 28.

The operation of the general reciprocating compressor constructed as described above will now be explained.

When power is applied to the winding coil 20, a flux is formed around the winding coil 2, a flux is formed around the winding coil 20, forming a closed loop along the outer stator 16 and the inner stator 18. By the interaction of the flux formed between the outer stator 16 and the inner stator 18 and the flux formed by the magnet 22, the magnet 22 is linearly moved in an axial direction. When the direction of a current applied to the winding coil 20 is changed in turn, the magnet

22 is linearly and reciprocally moved as the direction of the flux of the winding coil 20 is changed.

Then, as the motion of the magnet 22 is transferred to the piston 26 by the magnet holder 24, the piston 26 is linearly and reciprocally moved inside the cylinder 28, thereby compressing a refrigerant.

That is, when the piston 26 is retreated, the refrigerant is supplied to the compression chamber 36 through the suction opening 30 formed at the piston 26. When the piston 26 advances, the suction opening 30 is closed by the suction valve 32 and the refrigerant inside the compression chamber 36 is compressed, which is then discharged through the discharge pipe 4.

The lubricant 50 filled in the hermetic container 6 is pumped by the operation of the lubricant pumping unit 40 and supplied to the frictional portion between the piston 26 and the cylinder 28 through the lubricant supply passage 42, thereby performing a lubricating operation.

The refrigerant compressed by the reciprocating compressor constructed and operated as described above is a natural refrigerant which is environment-friendly and has combustibility and explosiveness.

As the natural refrigerant, an organic compound refrigerant consisting of only carbon and hydrogen is mainly used. Among organic compound refrigerants, hydrocarbon, consisting of only carbon and hydrogen, has no toxicity, is chemically stable, has a zero ozone depletion potential and a very low global warming index. Hydrocarbon includes R50 (methane), R170 (ethane), R290 (propane), R600 (butane), R600a (isobutene), R1270 (prophylene), etc.

Especially, isobutene (R600a) is hydrocarbon-based, has a molecular formula of CH (CH3)3, and is environment-friendly natural gas which does neither damage an ozone layer nor affect a greenhouse effect, and as such it is used as a refrigerant compressed by the reciprocating compressor of the present invention.

As the lubricant 50 for making a lubricating operation for the reciprocating compressor of the present invention, a mineral oil is used which has a favorable compatibility with hydrocarbon and satisfies physical and chemical characteristics.

The mineral oil is divided into a paraffin-based one and a naphtan-based one. In the present invention, the paraffin-based mineral lubricant is used.

It is preferred that the paraffin-based lubricant has a density of 0.866~0.880 g/cm^3 at a temperature of 15°C.

A flash point of the paraffin-based lubricant varies depending on a size and a type of the reciprocating compressor. Preferably, it is above 140°C, and it can be below 165°C, below 175°C, below 185°C and below 200°C according to the type of an adopted compressor.

A kinematic viscosity of the paraffin-based lubricant is preferably 7.2~21.8 mm^2/s at a temperature of 40°C, and most preferably, it is 8.29 mm^2/s and 10.3 mm^2/s depending on the size and type of an adopted reciprocating compressor.

A viscosity index of the paraffin-based lubricant is preferably 73~99.

A flow point of the paraffin-based lubricant is preferably below -25°C.

A total acid number of the paraffin-based lubricant is below 0.01 mgKOH/g.

The total acid number of the lubricant, representing an amount of an acid component contained in an oil, indicates an amount of potassium hydroxide required for neutralizing an acid component contained in 1g of sample oil by the number of mg.

A water content of the paraffin-based lubricant is preferably below 20 ppm.

A breakdown voltage of the paraffin-based lubricant is preferably above 30 kV.

As so far described, the reciprocating compressor for compressing a refrigerator of the present invention has such an advantage that since it uses the paraffin-based lubricant, a sort of the mineral oil with an excellent compatibility with the hydrocarbon, a natural refrigerant, compressed by the reciprocating compressor, the lubricating performance is improved and a life span of the reciprocating compressor is lengthened.

It will be apparent to those skilled in the art that various modifications and variations can be made in the reciprocating compressor of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.